

# **Disease Carrying Insects Program**

## **Developing a Sustainable Surveillance Program**

### **I. West Nile Virus**

2009 Annual Report and Comprehensive Plan for 2010

### **II. Tick and Tick Borne Disease Surveillance**

2009 Annual Report and Comprehensive Plan for 2010

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## **TABLE OF CONTENTS**

ABBREVIATIONS .....	3
DEFINITION OF TERMS AS USED IN THIS REPORT .....	4
ACKNOWLEDGMENTS.....	8
EXECUTIVE SUMMARY.....	9
I. WEST NILE VIRUS 2009 REPORT AND COMPREHENSIVE PLAN FOR 2010 .....	13
BACKGROUND.....	13
INTERIM REPORT AND ACTION PLAN, BY ACTIVITY .....	16
1. <i>Community Outreach and Public Education</i> .....	16
2. <i>Human Case Surveillance</i> .....	19
3. <i>Mosquito Surveillance</i> .....	22
4. <i>Environmental Considerations</i> .....	26
5. <i>Avian Surveillance</i> .....	26
6. <i>Source Reduction (elimination of standing water)</i> .....	28
7. <i>Larviciding</i> .....	29
8. <i>Operational Research</i> .....	30
9. <i>Adult Mosquito Control</i> .....	31
II. TICK AND TICK-BORNE DISEASE SURVEILLANCE 2009 REPORT AND COMPREHENSIVE PLAN FOR 2010.....	37
BACKGROUND.....	37
INTERIM REPORT AND ACTION PLAN, BY ACTIVITY .....	38
1. <i>Risk Communication, Community Outreach and Public Education</i> .....	38
2. <i>Human Case Surveillance</i> .....	39
3. <i>Tick Surveillance</i> .....	38
4. <i>Tick Identification</i> .....	39
III. RESOURCES.....	46
IV. MOSQUITO CONTROL REFERENCES AND LINKS.....	46

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## Abbreviations

ASTHO - The Association of State and Territorial Health Officials  
BOS - Fairfax County Board of Supervisors  
CB(s) - Catch Basin(s)  
CDC - Centers for Disease Control and Prevention  
CDPH - Chicago Department of Public Health  
CHS - Community Health and Safety  
CO<sub>2</sub> - Carbon dioxide  
CSF - Cerebrospinal Fluid  
EHS - Environmental Health Specialist  
DC - District of Columbia  
DCIP - Disease Carrying Insects Program  
DCLS - Division of Consolidated Laboratory Services (of Virginia)  
DEET - N,N-diethyl-m-toluamide (an insect repellent)  
DIT - Department of Information and Technology  
DPWES - Department of Public Works and Environmental Services  
EEE - Eastern Equine Encephalitis  
ELISA - Enzyme-Linked Immunosorbent Assay (a test to detect antibodies in serum)  
FCHD - Fairfax County Health Department  
FDA - Food and Drug Administration  
FIDO – Fairfax Inspections Database Online  
HMIS – Health Maintenance Information System  
IgG-ELISA - IgG Enzyme-Linked Immunosorbent Assay  
KAP - Knowledge, Attitudes and Practices  
LAC - LaCrosse Virus  
MAC-ELISA - IgM Antibody Capture Enzyme-linked Immunosorbent Assay  
MLE - Maximum Likelihood Estimate (a measure of infection rate of mosquitoes)  
MWCOG - Metropolitan Washington Council of Governments  
MSMS - Mosquito Surveillance and Management Subcommittee  
OPA - Office of Public Affairs  
PRNT - Plaque Reduction Neutralization Test (a test to determine virus type)  
RT-PCR - Reverse Transcriptase Polymerase Chain Reaction (a test to detect virus genetic material)  
SLE - St. Louis encephalitis  
TTY – Text Telephone  
ULV – Ultra-Low Volume  
URL – Uniform Resource Locator  
VA - Virginia  
VDH - Virginia Department of Health  
VDOT - Virginia Department of Transportation  
WN - West Nile  
WNND - West Nile neuroinvasive disease  
WNV - West Nile virus

## Definition of Terms as Used in this Report

**Active surveillance:** Health care providers or laboratories report notifiable diseases on a case-by-case basis or syndromic information in aggregate form on a regular schedule due to routine outreach from the local or state health agency.

**Adulticide:** An insecticide used to kill adult mosquitoes.

**Antibody:** A type of protein normally present in the body or produced in response to an antigen which it neutralizes, thus producing an immune response.

**Antigen:** A substance that stimulates an immune response (usually production of an antibody) when introduced into the body. Antigens include toxins, bacteria, viruses, and other foreign substances.

**Arbovirus:** An **Ar**thropod-**BO**rne **VIRUS**.

**Asian tiger mosquito:** Common name for *Aedes albopictus*.

**BG-Sentinel Trap:** A mosquito trap that attracts mosquitoes with its design and appearance, a special lure (BG-Lure) and CO<sub>2</sub> (produced by dry ice). A fan located below the intake tube sucks the mosquitoes into a collecting bag in the trap. The fan is powered by a 12 volt battery. This type of trap collects mosquitoes that are looking for hosts (which exhale CO<sub>2</sub> when they breathe and have a human skin scent). This trap is useful in collecting the Asian tiger mosquito, *Aedes albopictus*.

**Borrelia burgdorferi:** Scientific name of the bacteria that causes Lyme disease.

**Breeding site:** Larval mosquito habitat.

**Catch basin:** . Roadside inlet that permits rainwater to flow off the roadways. Part of the County's stormwater management system

**CDC miniature light trap:** A mosquito trap that attracts mosquitoes with light and CO<sub>2</sub> (produced by dry ice). A fan located below a light source sucks the mosquitoes into a collecting receptacle on the trap. The light is powered by a six-volt battery and the trap is covered by a plastic roof. This type of trap collects mosquitoes looking for hosts (which exhale CO<sub>2</sub> when they breathe).

**Common house mosquito:** In our area it is the common name given to *Culex pipiens*.

**Container breeder:** Mosquito species that lay their eggs in artificial (e.g., cans, bottles, tires, birdbaths and even catch basins) or natural (e.g., tree holes) containers.

**Corvids (Corvidae):** Family of birds that includes the crows, blue jays and magpies.

**Day degrees above 75°F:** The cumulative number of degrees Fahrenheit above 75° during the year.

**DCIP:** Disease Carrying Insects Program.

**DEET:** A synthetic chemical used as an ingredient in certain insect repellents. Recommended to protect against mosquitoes and ticks.

**Diapause:** A physiological state of dormancy usually controlled by hormones and environmental triggers. Many insects use diapause as a way to survive the winter.

**ELISA:** A sensitive immunoassay that uses an enzyme linked to an antigen as a marker for the detection of a specific protein in a blood sample. It is often used as a diagnostic test to determine exposure to a particular infectious agent, such as a virus.

**Encephalitis:** Swelling of the brain (as can be caused by the West Nile virus).

**Epidemiological Week (EPI Week):** This is a period of time that comprises seven days and is used to compare data from place to place and year to year. In the United States the first EPI Week is defined as the first week of the year ending on a Saturday, as long as four days of that year are included in that week.

**Epizootic:** An epizootic is the non-human equivalent of an epidemic, meaning that large numbers of animals are infected with a disease. An epizootic disease is one in which greater than normal numbers of animals are affected for a given place or time period.

**Gravid traps:** A mosquito trap baited with yeast-, grass- and hay-infused water that attracts female mosquitoes (primarily *Culex pipiens* and *Culex restuans*) that seek this type of water to lay eggs.

**HMIS:** Health Maintenance Information System; a database to manage health information.

**IgM antibodies:** The first class of antibodies produced by the immune system in response to the presence of an antigen (e.g. West Nile virus). Presence of IgM antibodies usually indicates a primary or recent infection. Diagnostic laboratories test for the presence of WNV-specific IgM antibodies in human serum or cerebrospinal fluid in order to confirm a case of WNV.

**IgG antibodies:** The second class of antibodies produced by the immune system in response to the presence of an antigen (e.g. West Nile virus). Presence of IgG antibodies usually indicates a past infection. Diagnostic laboratories test for the presence of WNV-specific IgG antibodies in human serum or cerebrospinal fluid, in order to confirm a case of WNV.

**IR3535:** A synthetic chemical used as an ingredient in certain insect repellents. Recommended to protect against mosquitoes.

**Larvicide:** An insecticide used to kill mosquito larvae.

**Lyme Disease:** Lyme disease was first identified in 1975 in Lyme, Connecticut, and is a bacterial illness caused by *Borrelia burgdorferi*. The disease is transmitted through the bite of an infected black-legged tick (*Ixodes scapularis*).

**Medical community:** Health care providers.

**Meningitis:** Swelling of the membrane covering the spinal cord or the membrane covering the brain (as can be caused by the West Nile virus).

**MIR:** Minimum Infection Rate. An estimate of the minimum number of infected individuals per 1,000 tested. Calculated as  $([\text{number of positive pools} / \text{total specimens tested}] \times 1000)$ . Useful when pool sizes are constant and infection rates are low.

**MLE:** Maximum Likelihood Estimate. An estimate of the maximum number of infected individuals per 1,000 tested. Recommended when pool sizes are variable and/or with large infection rates.

**Mosquito Dunks®:** A readily-available, non-restricted microbial larvicide which contains the active ingredient *Bacillus thuringiensis israelensis*. This product specifically targets mosquito larvae.

**Mosquito larva (plural: larvae):** The immature, aquatic, feeding stage of a mosquito. This is the stage that hatches from the mosquito egg and is the best target of a mosquito management program.

**Mosquito pool:** Mosquitoes that were collected in one location, on the same date, that have been grouped together (pooled) to be tested for the presence of a virus.

**MSMS:** Mosquito Surveillance Management Subcommittee. This is a subcommittee of Fairfax County's Environmental Coordinating Committee. The MSMS is composed of representatives from various county agencies and departments as well as other jurisdictions that have activities associated with DCIP.

**Neuroinvasive:** Affecting the nervous system. Refers to West Nile virus meningitis, encephalitis or other serious neurological pathologies.

**Oil of lemon eucalyptus:** A naturally-occurring chemical used as an ingredient in certain insect repellents. Recommended to protect against mosquitoes.

**Overwinter:** To pass the winter, like hibernation.

**Ovitrap:** Traps set out specifically to collect eggs of container-breeding mosquitoes, used to monitor species like the Asian tiger mosquito (*Aedes albopictus*).

**Parous:** Having produced offspring. Refers to an adult female mosquito that has laid eggs. This means a mosquito has taken a blood meal and could be infected with the virus, if the source of the blood meal had the virus.

**Passive surveillance:** Medical care providers or medical laboratories report notifiable diseases on a case-by-case basis to the local or state health agency, based upon a published list of conditions.

**Pathogen:** An infectious organism.

**Permethrin:** An insecticide that kills ticks and adult mosquitoes.

**PCR:** Polymerase Chain Reaction; a biochemical process that makes copies of a sequence of genetic material (DNA) so that its source can be identified.

**Picaridin:** A synthetic chemical used as an ingredient in certain insect repellents. Recommended to protect against mosquitoes.

**RAMP:** The RAMP® System consists of a portable scanning fluorescence analyzer and single-use, disposable test cartridges. The RAMP® West Nile Virus (WNV) Test is a highly sensitive prescreening test used for identifying WNV in mosquitoes and corvids.

**RT-PCR:** Reverse Transcription Polymerase Chain Reaction. A biochemical process that makes copies of a sequence of genetic material (RNA) so that its source can be identified.

**Trap period:** Period of time elapsed from when one trap is set to when it is collected. The trap period presently used by the DCIP is 24 hours.

**"Tip and Toss" campaign:** Part of Fairfax County Disease Carrying Insects Program involving the community to remove standing water from their yards, thus reducing mosquito breeding habitats.

**ULV:** Ultra-Low Volume. A method of applying insecticides to kill adult mosquitoes. It produces very small droplets of insecticide and is usually applied by a truck- or aircraft-mounted machine at a constant, predetermined rate.

**SLE:** St. Louis encephalitis.

**VectoLex®:** A biological larvicide (*Bacillus sphaericus*) used in catch basins to proactively suppress mosquito populations.

**West Nile fever:** A febrile condition caused by the West Nile virus, very similar to the flu. The symptoms include fever, body aches, swollen glands, rash and headache.

**West Nile virus:** A virus transmitted by mosquitoes. The normal transmission cycle is between certain species of mosquitoes and certain species of birds. It can be transmitted to and cause disease in other animals and people.

**West Nile virus “off-season”:** The period of time (usually November to April) marked by little or no mosquito activity, and no West Nile virus transmission.

**West Nile virus “season”:** The period of time (usually May to October) marked by high mosquito activity and West Nile virus transmission.

**Zumba™ Mosquito Trap:** A mosquito trap. Trap design and appearance, the BG-Lure, and CO<sub>2</sub> (produced by dry ice) draw host-seeking mosquitoes to the trap. A fan located below an intake tube sucks the mosquitoes into a collection bag. The fan is powered by a 12-volt battery. This type of trap collects mosquitoes attracted to hosts (which exhale CO<sub>2</sub> when they breathe). This trap is good at collecting *Culex* mosquitoes as well as *Aedes albopictus*.

## Acknowledgments

The Fairfax County Health Department (FCHD) would like to thank the members of the Mosquito Surveillance and Management Subcommittee (MSMS) of the County's Environmental Coordinating Committee for their guidance, and comments in the preparation of this document.

Parts of this plan are modeled after plans of the Centers for Disease Control and Prevention (CDC); the Virginia Department of Health (VDH); the Metropolitan Washington Council of Governments (MWCOG) and the Chicago Department of Public Health's (CDPH) 2003 WNV report. Recommendations and guidance were also obtained from a document issued by The Association of State and Territorial Health Officials (ASTHO).

### CDC

Epidemic/Epizootic West Nile virus in the United States: Revised guidelines for surveillance, prevention and control

[www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-aug-2003.pdf](http://www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-aug-2003.pdf)

### VDH

Virginia Arbovirus Surveillance & Response Plan, 2005

<http://www.vdh.virginia.gov/epidemiology/DEE/Vectorborne/responseplan/index.htm>

### MWCOG

West Nile Virus Response Plan for the National Capital Region

[www.mwcog.org/uploads/pub-documents/BFZd20040109135919.pdf](http://www.mwcog.org/uploads/pub-documents/BFZd20040109135919.pdf)

### CDPH

West Nile Virus 2006 Interim Report and Comprehensive Prevention Plan for 2007

[http://egov.cityofchicago.org/webportal/COCWebPortal/COC\\_EDITORIAL/WestNilePlan.pdf](http://egov.cityofchicago.org/webportal/COCWebPortal/COC_EDITORIAL/WestNilePlan.pdf)

### ASTHO

Public Health Confronts the Mosquito: Developing Sustainable State and Local Mosquito Control Programs; Interim Recommendations of the National Mosquito Control Collaborative

<http://www.astho.org/WorkArea/DownloadAsset.aspx?id=2333>



## **Executive Summary**

### **I. West Nile Virus 2009 Report and Comprehensive Plan for 2010**

In 2009, North America continued to experience the effects of West Nile virus (WNV). In 2009, at least 663 human cases with 30 deaths were reported in the U.S.<sup>1</sup>. There were four human case of WNV in 2009 in Virginia, and one of these occurred in Fairfax County. The National data set is not finalized and does not include any of the Virginia cases at the time of this report. From 2002 to present, there have been 23 human WNV cases, including 2 deaths, reported in Fairfax County.

This document reviews activities for 2009 and presents a surveillance plan for 2010 that will monitor mosquito populations to aid in minimizing the risk of WNV. The emphasis of the 2010 program will continue to be on surveillance, community outreach and public education, and a proactive larviciding program.

#### **Mosquito Surveillance**

The program is anchored by a strong surveillance component that will monitor mosquito populations during the 2010 mosquito season for possible increases in relative vector abundance and viral activity. Two new traps were introduced into the routine surveillance activities in 2008: the BG-Sentinel™ Trap and the Zumba™ Mosquito Trap. It is important to note that absolute high numbers of mosquitoes do not necessarily reflect high risk of human infection with WNV. Mosquitoes were collected during 4,135 trap periods in the 2009 season. A trap period was defined as 24 hours since some traps collected mosquitoes that were active during the day and others collected mosquitoes that were active at night. During the 2009 mosquito surveillance season, 136,636 mosquitoes were collected. Of 5,234 routine mosquito pools tested (which included 133,060 mosquitoes), 148 were positive for WNV.

#### **Risk Communication, Community Outreach and Public Education**

Fairfax County will continue to emphasize personal protection measures and mosquito and West Nile virus prevention and control. This is done through distribution of informational materials, media interviews, advertising, Web pages, presentations, and collaborations with community groups and homeowners associations.

The English “Reference Guide to Mosquitoes, Ticks, West Nile Virus and Lyme Disease”, which was mailed to every household in the County in April of 2008, was translated into Korean and Spanish in 2009 and mailed to these ethnic groups in the County. Other innovative distribution methods were utilized such as entering into partnership with Korean and Hispanic merchants to distribute the reference guides into the ethnic communities.

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<sup>1</sup> Data to Dec 8, 2009 obtained from CDC on March 4, 2010

The fifth 18-month “Fight the Bite” calendar was produced in 2009. The calendar included colorful and creative graphics, captions, facts, figures, important dates, and helpful hints for backyard mosquito and tick management, personal protection, and information about WNV and Lyme disease. Other vector control programs and health departments around the country continue to request authorization to use the County outreach materials and several of these have produced their own version, giving credit to Fairfax County.

### **Human Case Surveillance**

West Nile virus is one of 70 notifiable diseases and conditions in Virginia. The Fairfax County Health Department uses passive surveillance between November and June and active surveillance between July and October to monitor physician and laboratory reporting of WNV. The Health Department encourages physicians and laboratories to report cases of WNV by educating medical practitioners about the importance of reporting arboviral infections and by contacting key medical staff at hospital centers to inquire about the potential cases of WNV.

Reported WNV cases are classified as either West Nile fever or neuroinvasive WNV according to the case definition. In 2009, there was one case of WNV neuroinvasive disease in Fairfax County.

### **Environmental Considerations**

Air temperature, photoperiod and rainfall affect mosquito development. As in previous years, these factors were monitored in 2009 to better understand the relationship between climate and vector-borne diseases.

### **Avian Surveillance**

The number of dead birds reported to the County decreased in past years with a total of 187 dead birds reported in 2009. About 14 percent of the reported dead birds were crows. No dead birds were collected or tested for WNV in 2009. In 2010, FCHD will continue to ask citizens to report dead birds and may test selected birds for WNV.

### **Source Reduction**

The FCHD continued to promote source reduction (elimination of mosquito breeding sites) in 2009 through the outreach campaign. During more than 161 site visits and inspections, the DCIP educated property owners and managers about the benefits of eliminating breeding sites.

### **Larval Mosquito Control**

Catch basins are located throughout the County and are typically constructed to ensure proper rainwater drainage. However, they still hold water and can be important breeding sites for mosquitoes. During the 2009 season 99,327 CB's were treated in three cycles. From May to October, all the catch basins in the Huntington neighborhood of the Mount Vernon district, which floods periodically, were treated on a weekly basis.

In 2010, stormwater catch basins will be treated in programmed cycles aimed at reducing *Culex pipiens* mosquito populations, as has been done in previous years. The first cycle will begin in May 2010, and the number and magnitude of each cycle will be dependent on climatic factors and mosquito surveillance results.

### **Operational Research**

The Fairfax County Health Department conducts operational research and incorporated significant findings into routine actions. In 2007, FCHD looked into improved methods to collect mosquitoes and in 2008, based on the results obtained, introduced two new traps, the BG-Sentinel™ Trap and the Zumba™ Mosquito Trap, into the routine surveillance activities. Surveillance activities with these two traps were continued in 2009. We also continued to evaluate tires and corrugated pipes in the production of mosquitoes. Trapping results with new traps continues to be promising, particularly with respect to collecting WNV positive host-seeking mosquitoes. Both new traps were better than any other trap in collecting the Asian tiger mosquito. We will continue to use these two traps throughout the 2010 season.

### **Adult Mosquito Control**

A timely response to surveillance findings can reduce the overall impact of WNV and prevent human disease. Consistent with CDC, VDH and MWCOG guidelines, FCHD will implement an appropriate level of response based on surveillance data. The response levels range from a basic response level to a much heightened response (details are in the 2010 plan of action). In 2009, indicators were low enough not to warrant adulticiding. In 2010, mosquito species, habitat, weather, time of year and the proximity of infected mosquitoes to human populations will be considered in determining the necessity for adult mosquito control. Any use of adulticides will be under the direction of the County Executive and in coordination with any affected county, city or town within or adjacent to the treatment area.

## **II. Tick and Tick-Borne Disease Surveillance 2009 Report and Comprehensive Plan for 2010**

Fairfax County began tick and Lyme disease surveillance in 2005 with a small pilot program. In light of significant results from the first year of tick surveillance, the DCIP implemented an enhanced surveillance program in subsequent years. In 2009, 11,122 ticks (including 546 black-legged (deer) ticks) were collected in the spring and summer using standard trapping techniques and in the winter using host examination techniques.

The tick identification service that the DCIP began offering the County residents resulted in the identification of 154 ticks. Of these 33 (21.4%) were deer ticks.

The DCIP established a contract with an external laboratory to test ticks for pathogens and to date 1,189 ticks from four species have been tested. The results show that the infection rate in deer ticks is high and other tick species harbor other pathogens.

As in previous years, tick surveillance, the tick identification service and tick pathogen testing of ticks will be conducted by existing staff in the DCIP and will follow previously-established protocols. In 2010, the program will continue its outreach activities, as originally requested by the BOS in 2007.

# I. West Nile Virus 2009 Report and Comprehensive Plan for 2010

## Background

### Public Health Impact

West Nile virus infection causes illness in approximately one-fifth of the people infected. The majority of those infected with the virus does not show any symptoms and may never know they were infected. Symptomatic individuals typically experience “West Nile fever,” which includes a relatively mild fever, muscle aches, rash and headache. These cases are often undiagnosed and go unreported. A small percentage of infected persons develop a more significant illness such as meningitis, usually manifesting fever, headache and stiff neck; or encephalitis, which is accompanied with fever, headache and confusion or muscle weakness. Encephalitis, meningitis, and other WNV neuroinvasive illnesses require hospitalization and can be associated with prolonged recovery, disability, and even death. Recent post-hospitalization follow-up studies of WNV patients (University of Texas) indicate prolonged effects of the disease for up to three years, which may include personality change, depression or subsequent episodes of encephalitis. Treatment of West Nile virus infections is supportive since there is no specific drug that acts against the virus and, at present, no human vaccine available.

Primarily an infection of wild birds, WNV is transmitted by the bite of mosquitoes. The virus has been detected in 62 different mosquito species nationwide to date according to the CDC. The virus appears to be maintained in house sparrows (*Passer domesticus*). Infected mosquitoes can transmit WNV to birds, humans, and other animals while taking a blood meal. After the virus is ingested by the mosquito, it passes through the stomach wall into the body cavity where it replicates and eventually invades the salivary glands. During blood feeding the mosquito injects saliva into the host and in this manner the virus is passed to the animal or human, at times, infecting these hosts.

Since WNV first appeared in the United States in New York City in 1999, it has expanded across the United States. To the end of 2009, there have been about 29,624<sup>2</sup> cases of WNV human illness in the United States reported to CDC, including 1,161 deaths. Virginia has reported 74 human cases with four deaths.

In Fairfax County WNV was first detected in 2000, when a single crow was found to be infected. In 2001, additional infected birds were detected and in 2002, the virus was found in birds, horses, mosquitoes and humans. Since 2002 there have been 23 human cases of WNV with two fatalities reported in Fairfax County. One neuroinvasive human case of WNV was reported in 2009 (Table 1).

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<sup>2</sup> Data for 2009 is to Dec 8, 2009 obtained from CDC on March 4, 2010, and is not the final report.

**Table 1. West Nile Virus Infections in Birds, Mosquitoes, Horses and Humans in Fairfax County, 1999 – 2009.**

<u>Year</u>	<u>Bird</u>	<u>Mosquito Pools</u>	<u>Human</u>	<u>Horse</u>
1999	0	0	0	0
2000	1	0	0	0
2001	54	0	0	0
2002	70*	26	13/1**	3/1**
2003	15*	148	3/0**	2/1**
2004	3 <sup>&amp;</sup>	234	1/1**	0
2005	4 <sup>&amp;</sup>	33	0	0
2006	0 <sup>†</sup>	167	3/0**	0
2007	0 <sup>†</sup>	469	1/0**	0
2008	0 <sup>†</sup>	414	1/0**	0
2009	0 <sup>†</sup>	148	1/0	0

\*Testing of birds was suspended after 70 positive birds were detected in 2002 and 15 in 2003.

\*\* Cases / deaths.

<sup>&</sup>Limited (select) number of birds collected and tested.

<sup>†</sup>No birds tested.

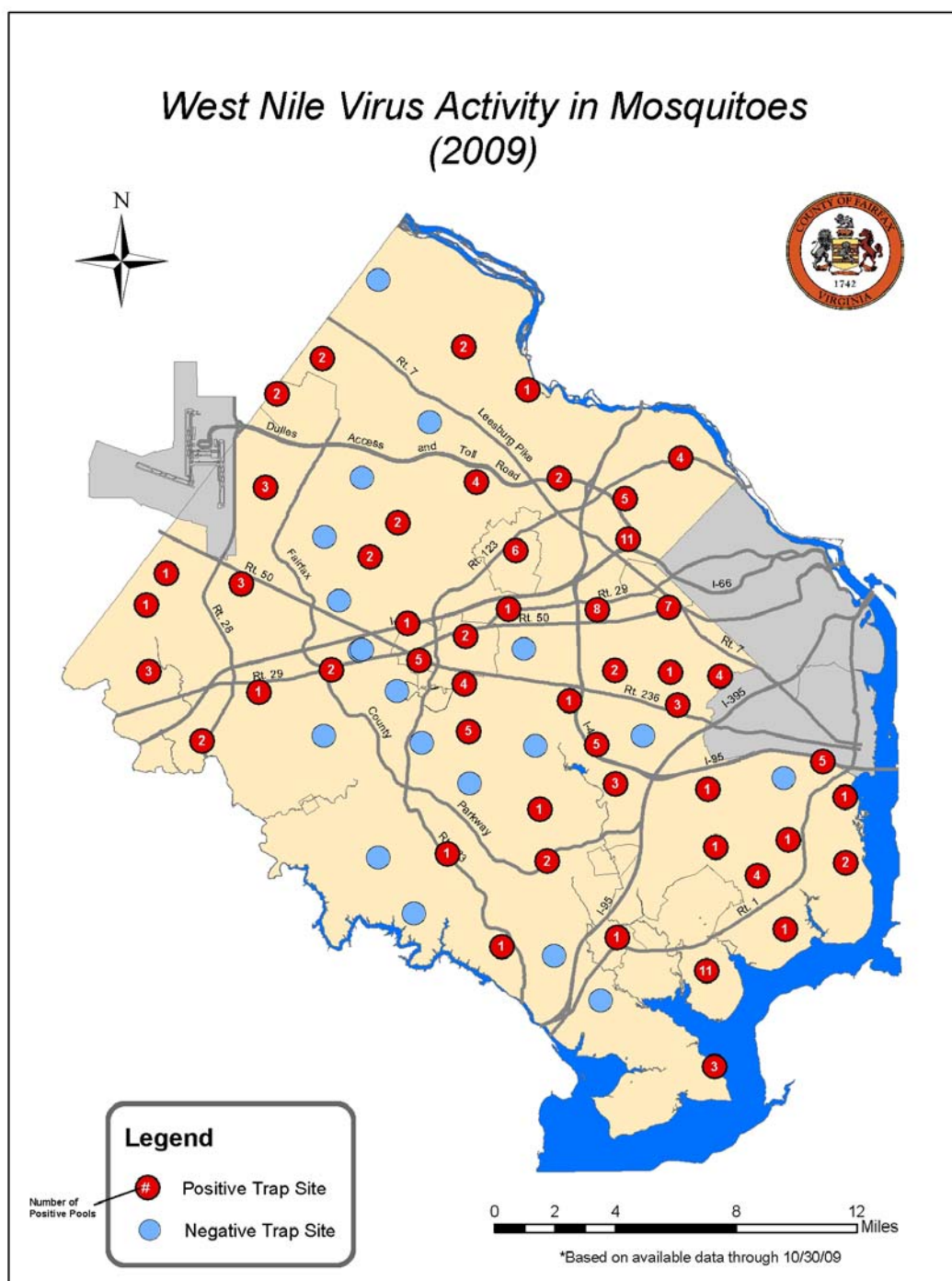
In Fairfax County, *Culex pipiens*, *Culex restuans*, *Culex erraticus*, *Aedes albopictus*, *Aedes vexans* and *Anopheles punctipennis* are the species that have tested positive for WNV and would most likely transmit WNV to humans. *Culex pipiens*, also known as the northern house mosquito, has been identified as the principal vector by calculating mosquito infection rates from 2002 through 2009. The vector status of *Culex pipiens* is supported by the findings of A.M. Kilpatrick et al. (Consortium for Conservation Medicine) demonstrating that *Culex pipiens* shifts its feeding preferences from birds to humans by seven-fold during late summer and early fall, coinciding with the dispersal of its preferred host (American robins, *Turdus migratorius*) and the rise in human WNV infections. This mosquito species prefers to lay its eggs in stagnant water rich in organic matter, such as that found in some stormwater catch basins. Larvae will hatch from these eggs before turning into pupae and finally become adult mosquitoes.

During the 2009 mosquito season in Fairfax County, 133,060 mosquitoes were tested in 5,234 routine pools. Of the pools tested, 148 pools were positive for WNV. In 2008, 130,002 mosquitoes were tested in 4,911 pools (samples), of which 414 were positive for WNV. In 2009, six species of mosquitoes (*Culex pipiens*, *Culex restuans*, *Ochlerotatus japonicus*, *Ochlerotatus triseriatus*, *Aedes vexans*, and *Aedes albopictus*) tested positive for West Nile virus. In previous years, *Culex erraticus*, *Culex salinarius* and *Anopheles punctipennis* have also tested positive for WNV in the County.

#### Preparation and Planning for WNV in Fairfax County

In 2009, one human and 148 mosquito pools were positive in the County. Positive mosquitoes were found throughout the County (see Map 1). During the 2009 season

Fairfax County continued with the comprehensive mosquito surveillance program, including 69 routine collection sites for a total of 4,135 trapping periods. We also had 22 trapping periods in response to mosquito complaints.



ap 1. West Nile Virus Activity in Mosquitoes, 2009

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The established, in-house surveillance system will continue to be the foundation of the Disease Carrying Insects Program. This will enable the FCHD to detect WNV and respond in a timely fashion.

The County is participating in a wide array of ongoing activities and undertaking new initiatives to enhance WNV prevention and mosquito control and better understand the transmission dynamics of the virus.

Effective July 1, 2003, the majority of funding for the Fairfax County WNV program was moved to Fund 116 (The Integrated Pest Management Program Fund) giving it the resources necessary for stability and effectiveness by including the program in a special tax district.

Working with a contractor, the FCHD has monitored mosquito breeding sites in Fairfax County for seven years. These breeding sites will continue to be monitored in 2010 and treated with the biological larvicide VectoLex® (*Bacillus sphaericus*), as necessary, when mosquito breeding is detected.

To keep County residents informed, the FCHD constantly reviews and updates public information materials in English and other select languages. In order to meet the needs of ethnic groups in the County, key elements of these materials have been translated into Chinese, Farsi, Korean, Spanish, Urdu, and Vietnamese. Fact sheets, brochures, and posters discussing actions Fairfax County residents can take to reduce mosquito populations (by eliminating sources of standing water), as well as personal protection from mosquito bites, have been widely disseminated from 2003 to present. In 2009, a "Reference Guide to Mosquitoes, Ticks, West Nile Virus and Lyme Disease" was translated into Korean and Spanish and mass mailed to corresponding ethnic residences in the County.

## **Interim Report and Action Plan by Activity**

### **1. Community Outreach and Public Education**

*Goal: To increase the public's knowledge about WNV, its consequences and mosquito control; to promote behavioral changes and to encourage the community to take an active role in reducing the risk of mosquito-borne diseases through preventive measures such as source reduction and personal protection.*

#### Background and Report on 2009 Activities

In 2009, the County continued to aggressively disseminate public information materials to encourage Fairfax County residents to eliminate and/or treat standing water around their homes and to reduce their risk of infection by avoiding mosquito bites. Since most of the mosquitoes that bite around the house also breed around the house, removing breeding sites, using repellent, and treating the property with an adulticide will help reduce human–mosquito contact. Many news releases, news conferences and expert



interviews with print and broadcast media in English and Spanish were used to deliver prevention messages. Documents and brochures with the slogan “Fight the Bite” have been distributed through Board of Supervisors’ offices, libraries, fairs, presentations, by mail and in some schools during the last six mosquito seasons. Information was also provided regarding the clinical spectrum of illness and prevention of WNV infection. In all of the WNV public information messages, the Health Department underscored the elimination of standing water and personal protection against mosquito bites.

In April 2008, the DCIP translated the “Reference Guide to Mosquitoes, Ticks, West Nile Virus and Lyme Disease” into Korean and Spanish and it was mass mailed to corresponding ethnic residents in the County. In June the DCIP presented its fifth 18-month calendar full of bright, colorful, and humorous graphics. The graphics in the calendar were accompanied by captions, facts, figures, important dates, and helpful reminders relating to West Nile virus, Lyme disease, and preventive measures. Important behaviors such as cleaning gutters, emptying bird baths, filling depressions in the yard, and wearing insect repellent were strategically stressed throughout the calendar. General facts, local figures, and brief descriptions of the County’s efforts were included to educate the public about basic mosquito biology and inform them specifically about mosquitoes and West Nile virus in Fairfax County. These calendars were distributed at DCIP events and to all Fairfax County fourth grade students through a collaborative effort with the Fairfax County Public Schools. By the end of the year, 20,000 calendars were distributed. Other jurisdictions, have requested permission to use the calendar graphics and materials. Another 18-month calendar for 2010-2011 is in preparation.

The DCIP also prepared a book entitled “The ABC’s of Bites” as a means of taking mosquito information to parents and children. The author/illustrator was present with us at two outreach events to sign autographs as part of a “Meet the Author” activity. This action proved quite successful and brought in many families.

Many inquiries regarding WNV and mosquito breeding sites were received by the DCIP via direct telephone calls and two Web-submission forms available on the “Fight the Bite” Web page. Both Web submission forms route messages directly to the “Fight the Bite” e-mail address, which is the Fairfax County Health Department’s dedicated WNV e-mail ([fightthebite@fairfaxcounty.gov](mailto:fightthebite@fairfaxcounty.gov)). We made 161 house visits during the summer months helping people resolve their mosquito and tick problems.

Planned Activities for Risk Communication, Public Education and Community Outreach  
Public outreach, information, and education are mainstays of the DCIP and will continue to be emphasized during the 2010 season. All materials will be reviewed and updated (particularly the tick brochure after recent findings in 2009) and new materials will be prepared to better reach County residents. Key materials will continue to be distributed in Chinese, Farsi, Korean, Spanish, Urdu and Vietnamese.

The FCHD, with assistance from the Office of Public Affairs (OPA), will be the lead agency on content for WNV publications, posters, etc. and will make this information available to all interested County agencies and pertinent jurisdictions. The County will continue to use the “Fight the Bite” theme during 2010.

Key Communication, Education and Outreach activities:

- Revise and update the DCIP Web page.
- Prepare a 2010-2011 18-month calendar.
- Promote Mosquito Control Awareness Week throughout the County.
- Distribute CDC literature on WNV and the outdoor worker.
- Evaluate media strategies used in other areas of the country and incorporate them into the program as feasible.
- Beginning mid-April, key messages will be disseminated through news releases, interviews, and public service announcements. Most will aim to elevate the population’s awareness of WNV and steps that individuals can take for personal protection.
- Prepare 30-second movie theater PSA with the help of Health Department Public Information Officer as part of Health Department’s outreach program.
- Prepare, proof, print, and distribute a second children’s book on mosquitoes and ticks and the actions that can be taken to protect one self against West Nile virus and Lyme disease.
- DCIP staff will work with OPA and the Board of Supervisors’ offices to reach the constituents in each of the districts.
- Fairfax County Print Shop will be contacted to produce outreach and educational material year-round, as needed.
- Posters and brochures will be distributed at, by or through:
  - Fairs
  - Homeowners Associations
  - Civic Associations
  - Posters in public buildings
  - Clinic room aides and public health nurses (Schools)
  - Farmers Markets
  - “Fight the Bite” Web page ([www.fairfaxcounty.gov/fightthebite](http://www.fairfaxcounty.gov/fightthebite))
  - HD/Community Health and Safety staff
  - Clinic and physician waiting rooms
  - Conferences and scientific meetings
  - Other distribution methods as available.
- During special events and through the Board of Supervisors’ offices:
  - Information about the use of Mosquito Dunks® and other larvicides will be presented to the community as an option for larval reduction, in areas where the “tip and toss” campaign cannot be implemented.
  - Information about the use of repellents containing DEET, Picaridin, IR3535 or oil of lemon eucalyptus will be presented to the community as an option for personal protection against mosquito bites.

- If surveillance information demonstrates potential human risk of infection with WNV, media messages will:
  - Emphasize personal protection against mosquito bites using “Fight the Bite” recommendations.
  - Help Fairfax County residents ensure personal protection for themselves and family members.
  - Target traditional media outlets as well as community newspapers in multiple languages and in multiple neighborhoods.
- If the available surveillance information suggests imminent and substantial risk to human health and adult mosquito control is recommended, the FCHD will enhance its efforts to provide complete, timely, and accurate information on spray areas, spray schedule, and measures people can take to reduce exposure.
- Timeline of Activities:
  - Throughout the year, as necessary, the County will prepare and provide WNV-related media stories.
  - From June to October 2010, as determined by mosquito and WNV activity, the “Fight the Bite” campaign to reduce infection by reducing mosquito bites will be intensified.
  - Throughout the year outreach activities will be implemented as the need demands.
  - New materials will be prepared or acquired to target specific issues or groups for WNV information and protection.
  - During winter months (2010-2011), the DCIP will review and update all outreach materials, prepare new material as needed. Material will be printed and prepared for distribution to targeted groups.

## **2. Human Case Surveillance**

*Goal: To promptly detect, investigate, and report cases of human WNV disease to enable timely implementation of prevention and control measures to prevent further cases, if indicated; to assess and document the public health impact of WNV disease in Fairfax County.*

### Introduction and Report of Previous Activities

In 2010, the Fairfax County Health Department (FCHD) continued to use a system of enhanced passive surveillance to detect cases of WNV disease, and worked to improve the quality and timeliness of reporting. FCHD also continued efforts to identify suspected WNV cases with higher risk of non-vector borne disease transmission, including individuals who had recently received or donated blood products or organs, and nursing or pregnant mothers.

Arboviral infection is one of more than 70 reportable diseases and conditions in Virginia, and physicians are required to report all suspect cases to local health departments (including FCHD). In addition to physician reports, FCHD also receives reports of suspect cases of arboviral infection from commercial laboratories, hospitals, the Division

of Consolidated Laboratory Services (DCLS), and the Virginia Department of Health Office of Epidemiology.

All suspect cases of arboviral disease reported to FCHD are investigated. Suspect cases meeting the clinical criteria for West Nile neuroinvasive disease or West Nile fever with laboratory evidence of recent infection (presence of IgM antibodies) are classified as “confirmed” or “probable,” depending on the strength of the supporting laboratory evidence. Cases of arboviral disease are classified either as neuroinvasive (WNND) or non-neuroinvasive (West Nile fever) according to the following criteria:

*Neuroinvasive disease* requires the presence of fever and at least one of the following, as documented by a physician, and in the absence of a more likely clinical explanation:

- Acutely altered mental status (e.g., disorientation, obtundation, stupor, or coma);
- Other acute signs of central or peripheral neurologic dysfunction (e.g., paresis or paralysis, nerve palsies, sensory deficits, abnormal reflexes, generalized convulsions, or abnormal movements); or
- Pleocytosis – increased white blood cell concentration in cerebrospinal fluid (CSF) associated with illness clinically compatible with meningitis (e.g., headaches or stiff neck).

*Non-neuroinvasive disease (West Nile fever)* requires, at minimum, the presence of documented fever (measured by the patient or clinician), the absence of neuroinvasive disease (above), and the absence of a more likely clinical explanation for the illness. Involvement of non-neurological organs (e.g., heart, pancreas, liver) should be documented using standard clinical and laboratory criteria.

Whenever possible, serological and/or CSF specimens from suspect arboviral cases are forwarded to DCLS for laboratory confirmation. Serological specimens are evaluated by DCLS using a highly-specific IgM Microsphere Immuno Assay (IgM MIA) to detect IgM antibodies specific to WNV and SLE. An IgM antibody capture enzyme-linked immunosorbent assay (MAC-ELISA) is used to detect IgM specific to Eastern Equine Encephalitis (EEE) and, for samples from individuals less than 20 years of age, Lacrosse virus (LAC). An IgG ELISA is used to identify WNV, SLE, EEE, and LAC-reactive antibody in IgM positive and convalescent samples. (Note: A negative IgM-MIA or MAC-ELISA on a specimen taken soon after illness onset (<10 days) does not rule out arboviral infection. Whenever possible convalescent sera are collected to determine if WNV infection is present or absent in these cases.) Serological specimens from patients with detectable levels of WNV-specific IgM and IgG are confirmed with a plaque reduction neutralization test (PRNT), as appropriate. CSF specimens are evaluated using IgM MIA and MAC-ELISA.

Patient information and laboratory data is shared between the VDH Office of

Epidemiology and FCHD in person, via telephone or via fax to facilitate case surveillance and timely reporting of laboratory results to FCHD. Results reported to the FCHD about residents of other districts are forwarded by fax or mail to the appropriate local health department (in VA and the DC metro area) or state health department (for out-of-state residents). When laboratory results are negative, a report is sent to the original collecting physician. When laboratory results are equivocal, the collecting physician is notified and a convalescent sample may be requested. When laboratory results are positive, the collecting physician is notified and a convalescent serum sample may be requested. Positive results are investigated and assigned a PIN number in AVATAR (an FCHD database). In addition, positive results are entered into the National Electronic Disease Surveillance System.

#### Cases of West Nile Virus Disease in Fairfax County in 2009

In 2010, one confirmed human case of WNV disease was identified in Fairfax County. This case met the criteria for WNND.

Please note that this data is subject to change as 2009 cases are finalized during the first several months of 2010.

#### Planned Surveillance Activities for WNV

In 2010, FCHD will continue to implement a system of enhanced passive surveillance for arboviral infection, including WNV disease. If deemed necessary, active surveillance will be instituted based on the results of passive human case surveillance, mosquito surveillance, and any changes in the epidemiology of WNV disease in surrounding counties or in the state.

As in 2009, enhanced passive surveillance will have two main components:

- 1) *Educating the medical community.* The FCHD will work to maximize physician reporting of WNV disease by: raising awareness within the medical community of the importance of reporting suspected infection, educating hospital infection control personnel and physicians on the criteria for reporting cases, and providing instructions for submission of appropriate laboratory specimens.

FCHD will continue to encourage physicians to:

- Consider arboviral infection in patients hospitalized with encephalitis of unknown etiology, particularly during the peak months of mosquito activity and viral amplification (July-October);
- Consider WNV in suspected cases of Guillain-Barre syndrome, botulism, and muscle weakness or flaccid paralysis; and
- Determine if there is a history of donating or receiving blood or organs or if the patient is pregnant or breast-feeding when WNV infection is diagnosed.

As in 2009, testing for WNV will be performed by DCLS. FCHD will continue to work with health care providers to ensure that appropriate specimens are submitted for

testing.

- 2) *Laboratory surveillance.* The FCHD will continue to investigate reports of sero-positive cases of arboviral infection submitted by commercial laboratories, hospitals, physicians, Division of Consolidated Laboratory Services (DCLS), and the Office of Epidemiology. FCHD will ensure that hospitals and laboratories are aware of the latest surveillance criteria, and have the information and materials necessary to forward diagnostic specimens to DCLS.

FCHD will also continue to encourage both physicians and laboratories to complete all essential information on the laboratory submission forms. Accurate interpretation of serological findings requires knowledge of the patient's clinical history.

#### Additional Surveillance Activities for WNV

Given evidence suggesting the potential for non-vector borne WNV transmission, FCHD will continue to determine if any human cases of probable or confirmed WNV infection:

- Received an organ transplantation or blood transfusion within the four weeks prior to illness onset, or acted as a blood donor during the two weeks prior to illness onset;
- Are pregnant or breast-feeding mothers; or
- Resulted from occupational exposure.

The VDH Office of Epidemiology will be notified in a timely fashion of any potential non-vector borne WNV transmissions. A trace-back investigation of transplant or transfusion cases would involve the CDC and the Food and Drug Administration (FDA).

Please note: This Human Case Surveillance Plan may be updated, as needed, to reflect local surveillance needs, resources, or changes to guidelines from the Virginia Department of Health or the Centers for Disease Control and Prevention.

### **3. Mosquito Surveillance**

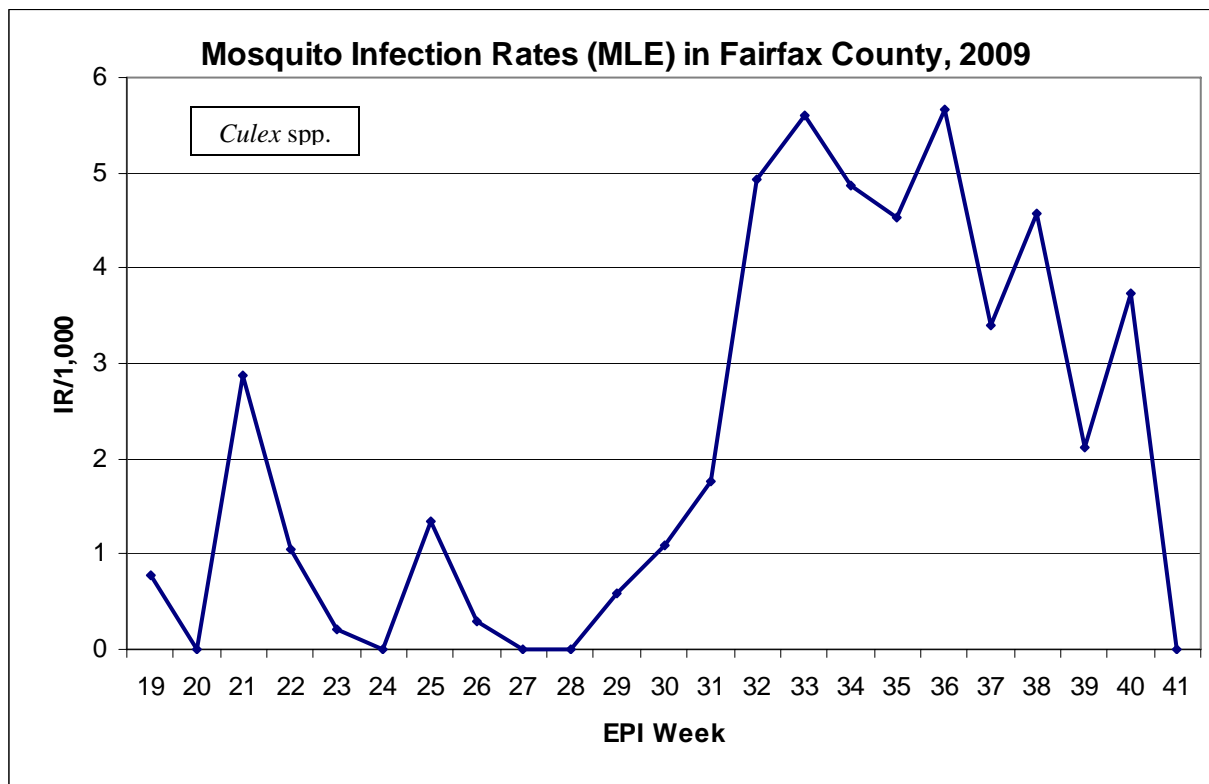
*Goal: To maintain a sustainable surveillance program to monitor vector mosquito populations and their WNV infection rates, as well as other associated factors that will allow the program to predict the risk of WNV transmission to humans.*

#### Background and Report on 2009 Activities

**It is important to note that absolute high numbers of mosquitoes do not necessarily reflect high risk of human infection with WNV.** High mosquito counts, even if the mosquito species involved may bite humans, are usually from large broods of floodwater “nuisance mosquitoes” such as *Psorophora* sp., which are less important than *Culex* or *Aedes* mosquitoes, in WNV transmission. Fortunately, the Northern house mosquito, *Culex pipiens*, feeds much less frequently on humans than *Ae. vexans* or *Ae. albopictus*.

Based on our initial operational research results from 2007, we have included 21 Zumba traps and 21 BG-Sentinel traps in our routine 2008 and 2009 surveillance program to further evaluate their performance. Both traps were superior to the CDC (host-seeking) trap that we routinely use. These new traps were particularly effective in collecting *Culex* mosquitoes as well as *Aedes albopictus*, the Asian tiger mosquito.

In the 2009 season, a total of 136,636 mosquitoes were collected over 4,135 trap-days. The FCHD tested 5,234 routine samples (pools) (which included 133,060 mosquitoes) for WNV testing and 148 of those pools were positive. Another 4,113 mosquitoes were collected as part of operational research or in response to citizen complaints. Another 173 mosquito pools (3,866 mosquitoes) were tested for WNV, and nine of those pools were positive. From this information the DCIP was able to determine that the Maximum Likelihood Estimate (MLE), or infection rate, of *Culex* mosquitoes ranged from zero to 5.7 per 1,000 mosquitoes during the season (Figure 1).



**Figure 1. Maximum Likelihood Estimates of West Nile virus infection, per 1,000 mosquitoes, in *Culex* mosquitoes found in Fairfax County, 2009.**

There were two early peaks of WNV activity in the mosquitoes in early spring with infection rates of 2.87 in week 21 and 1.34 in week 25. After this, the first WNV positive

mosquito was collected in week 29 (one week later than the previous year) the peak infection rate was seen in week 36 and the virus was active throughout the rest of the surveillance season to week 40. The observed infection rates were much lower than those seen in 2004, 2006, 2007 and 2008, but comparable to those seen in 2005.

The infection rate in other mosquitoes was very low and only was seen in the early part of the year when the two small peaks occurred in the *Culex* mosquitoes. WNV in other species other than *Culex* was not apparent in the later weeks of the season.

Of the mosquitoes tested in 2009, six species were positive for WNV: *Aedes albopictus*, *Aedes vexans*, *Culex pipiens*, *Culex restuans*, *Ochlerotatus japonicus* and *Ochlerotatus triseriatus*. *Culex pipiens* and *Culex restuans* are the two species which are most frequently infected with WNV in the County and are mosquitoes that prefer to breed in stagnant water. In Fairfax County, catch basins and artificial containers appear to be the preferred breeding site for *Cx. pipiens*, while above ground pools of stagnant water are the preferred breeding sites for *Cx. restuans*.

After the flood in the Huntington area of the County in 2006, we continued mosquito surveillance in the area in through 2009. The results from the three previous years showed high mosquito densities with high WNV infection rates in various mosquito species; however, in 2009, WNV activity was much reduced. Catch basins in the Huntington area were treated weekly with a larvicide. As in other years, larvicide will be applied to the Huntington area in 2010 in the event of a heavy rainfall.

The Asian tiger mosquito (*Aedes albopictus*) was the source of the majority of mosquito-related complaints received in 2009. This mosquito is an aggressive, persistent biter that can be found in large numbers around residences. Several factors contributed to the presence of *Ae. albopictus* around these homes; however, the presence of black corrugated pipes at the end of the downspouts from the roof gutters seemed to be a key source of the problem. Most of these corrugated pipes did not drain properly or adequately and they retained water throughout the season, thus providing great mosquito breeding habitat. Furthermore, the large number of foreclosed houses in the County increased the number of breeding sites around houses and equally increased the complaints due to *Aedes albopictus*.

In 2009, the FCHD continued to monitor and identify mosquito breeding sites throughout Fairfax County and treated the sites that contained mosquito larvae with a larvicide. The four year database of breeding sites will continue to serve as a guide to inspect and treat the breeding sites in the County on a monthly basis during 2010.

In previous years, mosquito testing for arboviruses was performed by the Virginia Division of Consolidated Laboratory Services (DCLS). In 2009, the DCLS announced that they would no longer test mosquitoes. A suitable replacement laboratory that could handle volume of mosquito pools generated by the FCHD mosquito surveillance system



could not be found, so it was decided to bring testing in-house. The DCIP researched options and decided to use the commercially available, desktop RAMP (Rapid Analyte Measurement Platform) testing system as a way to screen the mosquito pools. If a tested mosquito pool yielded a reading of 30 RAMP Units or more, it was sent out for confirmation by RT-PCR in another facility. Once the FCHD Laboratory is completed (estimated move-in date is May, 2010), the County will be closer to having the capacity to perform RT-PCR to detect WNV in mosquitoes. We will continue to use the RAMP system until the laboratory's RT-PCR system is set up and validated.

After some training and collaboration, Ft. Belvoir is carrying out regular mosquito surveillance activities and the mosquitoes are being tested by the County and incorporated into the data set.

#### Planned Activities for Mosquito Surveillance

FCHD mosquito surveillance activities for 2010 are as follows:

- Continue to conduct mosquito surveillance at approximately 70 trap sites throughout the County plus those in Ft. Belvoir.
- Associate mosquito trap data with risk factors to assess how to predict human risk and refine “triggers” for mosquito control activities.
- Sort each trap collection by mosquito species and record information on location, collection data, trap type and the total number of female mosquitoes and test mosquitoes for WNV.
- Re-evaluate trap sites to be used during the 2010 season to ensure homogeneous coverage of the County.
- Conduct additional adult mosquito trapping in areas where conditions suggest a public health threat. This will help determine zones of potential local transmission and determine the extent of viral activity thus guiding interventions.
- Conduct additional mosquito trapping to evaluate the efficacy of control measures in the event that pesticides are applied for adult mosquito control.
- Increase trapping efforts in areas where surveillance indicators suggest an increase in WNV activity.
- Continue to use new traps and products, particularly those that will enhance mosquito surveillance or capture species that are not readily collected by other traps.
- Continue to evaluate new traps and products (attractants, baits, etc.), particularly those that will enhance mosquito surveillance, capture species that are not readily collected by other trapping methods (i.e. *Aedes albopictus*) or collect WNV vector species more efficiently.
- Ensure adequate routine inspection of suspected breeding sites to determine the presence of larvae.
- Collect and update larval habitat information throughout the season (May-October) and treat sites that produce mosquitoes.
- Continue to test mosquitoes with the RAMP system and help set up and validate the RT-PCR.
- Respond to residents' concerns regarding mosquitoes in a timely manner.

- Share information in a timely fashion with the contractor, County agencies and neighboring jurisdictions regarding sites needing larvicide, as appropriate.

#### **4. Environmental Considerations**

*Goal: To monitor environmental factors (temperature, rainfall, and photoperiod) to correlate with surveillance results and WNV circulation to determine those factors that may influence WNV transmission.*

##### Background and Report on 2009 Activities

It is apparent that some of the factors associated with WNV transmission are temperature, rainfall, and photoperiod (day length). Cooler temperatures prolong the development of the virus in the mosquito, requiring a longer period for mosquitoes to become infective. Lower temperatures also prolong the larval development of mosquitoes, keeping them in breeding sites as immature larvae for longer periods of time. Frequent and abundant precipitation also creates a flushing effect of catch basins and other breeding sites, washing out mosquito larvae that may be present.

While climatic factors can't be controlled or modified, monitoring them will help understand their effect on mosquito-transmitted diseases. In 2010, the FCHD will continue to monitor climatic factors, in order to be able to correlate them with either disease or mosquito abundance.

##### Planned Activities for Environmental Considerations

- Continue to monitor climatic factors in 2010, and correlate them with both disease and mosquito abundance.
- Official (NOAA) weather data will be collected from weather stations at Ronald Reagan Washington National Airport and Washington Dulles International Airport on a daily basis and recorded electronically.
- Weather trends will be monitored and correlated with surveillance information to help predict mosquito population variation, viral activity, and human infection.
- As necessary, site-specific temperature data will be collected using an environmental data logger.

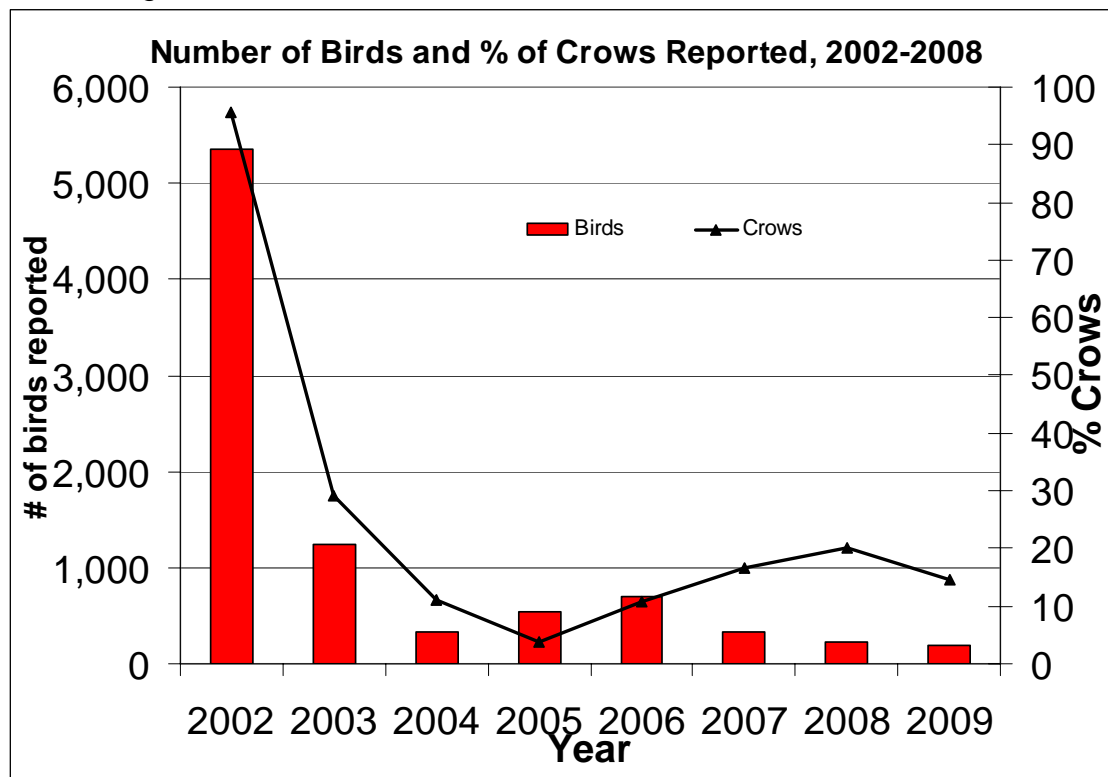
#### **5. Avian Surveillance**

*Goal: To use avian mortality records and WNV infection in birds as an additional indicator of WNV activity in Fairfax County to help predict the spread of the virus before the onset of human illness.*

##### Background and Report on 2009 Activities

While many species of birds have tested positive for WNV in the past, crows and blue jays have been particularly susceptible to the disease and are readily identified by the public.

In 2009, the number of dead birds reported was 187, fewer than the number reported the previous years (Figure 2). No birds were tested for WNV as DCLS no longer performs bird testing.



**Figure 2. Number of dead birds reported and percentage of these that were crows from 2002 to 2009 in Fairfax County.**

Data collected since 2002 indicates a sharp decline in the number of dead bird reports to the FCHD to 2004. Since then, the number of reports has stabilized and remained fairly constant, with slight yearly variation. The greater part of this decline is due to the decreased number of dead crows reported, the assumed complacency in reporting by the community since birds are no longer tested for WNV and we rely on a passive reporting system, and the shift to a mosquito-based surveillance system.

The percentage of dead crows reported in 2009 (14.44 percent) is lower than that reported in the past three years. Although crows initially served as first indicators of WNV in the County, they are not useful in this capacity at present but may be an indicator of virus circulation.

By incorporating a RAMP® System for WNV detection in mosquitoes, we will also have the capability to test dead birds for WNV if the need arises.

#### Planned Activities for Avian Surveillance

- As in 2009, FCHD will continue to monitor dead birds reported by the public through the call-in phone line 703-246-2300, TTY 711, or by e-mail through the County's WNV Web page [www.fairfaxcounty.gov/fightthtebite](http://www.fairfaxcounty.gov/fightthtebite).
- Reported dead bird information will be used by the FCHD to enhance its disease surveillance program, even if the bird is not picked up.
- Clear public messages regarding bird testing and disposal will continue to be disseminated by all possible means.
- Throughout the year the FCHD will geocode and map dead birds as they are reported. Mapping will be done for all birds and corvids, as well as any WNV positive birds. These maps will show geographical groupings of dead birds. This data will be compared to other WNV surveillance and control events.
- An appropriate sample of dead birds, especially crows and blue jays that have died within the previous 24 hours, may be tested for WNV.

## **6. Source Reduction (elimination of standing water)**

*Goal: To reduce the number of adult mosquitoes by eliminating potential mosquito development sites.*

### Background and Report on 2009 Activities

All mosquitoes begin their life in water. *Culex pipiens* and *Culex restuans*, the primary vectors of WNV in Fairfax County, and the Asian tiger mosquito (*Aedes albopictus*) are three mosquitoes commonly found in urban areas. The *Culex* mosquitoes breed quickly and lay their eggs on standing water. The Asian tiger mosquito is the primary nuisance and main backyard mosquito in the County. It lays its eggs in artificial containers around the home. Prime sites for all these mosquitoes to develop around homes include discarded tires left outdoors, poorly maintained bird baths, clogged rain gutters, poorly maintained swimming and plastic wading pools, pots, black corrugated drain pipes, and puddles that last for a week or more. Eliminating these sites is the simplest and most effective way to reduce the number of mosquitoes. Every residential and commercial property owner should regularly inspect their property and buildings to determine if conditions are conducive to mosquito development and endeavor to eliminate those conditions. Mosquito development can be prevented by either eliminating the standing water (source reduction) or treating the water with larvicide to prevent mosquitoes from growing, if source reduction is not possible.

The County's WNV community outreach, information, and public education campaign highlights the need for residents to eliminate mosquito-breeding sites around their homes. Diagrams of potential sources around the home were described in multiple media events and languages as well as on the WNV Web page.

In 2009, the DCIP assisted residents in 161 complaints. Most of the mosquito complaints were for the Asian tiger mosquito. Many complaints were related to foreclosed houses and abandoned swimming pools.

In 2010, the DCIP will continue to receive complaints from residents regarding standing water and mosquito development sites throughout the County and take the appropriate action to abate them.

#### Planned Activities for Source Reduction

- The DCIP will work with homeowners' associations to promote community participation and distribute printed information on the need to eliminate mosquito-breeding sites on their property or to properly treat them with larvicide.
- The telephone line (703-246-2300, TTY 711) will continue to receive complaints on mosquitoes and standing water.
- Complaints will be logged in the FIDO system and addressed by the health inspector.
- County residents will be asked to eliminate standing water on private property or to report standing water to (703-246-2300, TTY 711), if it is on public property.
- The FCHD will communicate with owners or managers of cemeteries, country clubs, and other institutions of concern to develop a plan that addresses the abatement of standing water.
- The FCHD will work closely with the DPWES on mosquito problems in stormwater retention/ detention ponds.
- FCHD will route mosquito issues in roadside canals and blocked catch basins to VDOT.
- In collaboration with Fairfax County Public Schools, mosquito populations will be monitored and controlled on the school campuses in the County.

### **7. Larviciding**

*Goal: To reduce the number of adult Culex mosquitoes by applying environmentally safe larvicides in breeding sites that cannot be drained.*

#### Background

Catch basins (CBs), also called storm sewers or stormwater catch basins, are located throughout the County. Catch basins usually drain well and do not present an opportunity for mosquito breeding; however, some (particularly those in older communities in the County) may have structural problems or may be partially blocked, retain water and produce excellent breeding sites for *Culex* mosquitoes. The exact number of CBs in the County is unknown, but it is estimated there are 75,000 to 100,000. Based on WNV data from previous years, the FCHD worked with a contractor and began treating CBs proactively, in predetermined areas of the County. . The larvicide used, VectoLex<sup>®</sup> (*Bacillus sphaericus*), is a naturally occurring soil bacterium that produces toxins which cause death in mosquito larvae. It is considered ideal for mosquito management because it will only affect mosquitoes and one other type of biting fly, and because of its very low toxicity to other organisms. During the 2009 season 99,327 CBs were treated in three treatment cycles. The number of cycles treated in a season is dependent on several factors, including weather, degree of viral activity, resources, etc. In addition to the routine monthly CB treatments, all the catch basins in the Huntington area were treated once a week to lower the *Culex* population.

Dr. Roger Nasci (CDC) has stated, “[WNV] programs with the most intensive larviciding had proportionally fewer human WNV cases.” Dr. Linn D. Haramis, (Illinois Department of Health), indicated that Cook County programs with the most intense larviciding programs had proportionately fewer WNV cases. Dr. Ned Walker, (Michigan State University), noted that in Michigan, the infection rate in mosquitoes was four per 1,000 in areas with catch basin control and 28 per 1,000 in areas without such control activities. Even though this data is not conclusive, it strongly supports CB larviciding at least until WNV transmission and factors affecting it are better understood.

#### Planned Activities for Larviciding

- The DCIP is planning three larviciding cycles in 2010. If needed, an additional cycle will be conducted.
- The Huntington (Cameron Run Park) area will be treated with a larvicide early in the season as an effort of reducing the mosquito populations.
- The Huntington area CBs will be treated on a weekly basis due to the tidal effect.
- The first round of CB treatments will begin in mid-May and will follow the programmed CB treatment order in the County tax map areas treated in 2009.
- The second and third rounds of treatment will follow the pre-established order.
- The DCIP will purchase sufficient larvicide for the FCHD and Fund 116 staff to treat larval development sites, as necessary, to abate immediate problems.
- The FCHD will inspect and larvicide the previously identified larval development sites.
- The FCHD will work in collaboration with the DPWES in the surveillance and larviciding of stormwater detention/retention ponds.
- The FCHD will verify WNV control and mosquito management plans of action through the regular meetings of the MSMS.
- The FCHD will continue to monitor CBs outside the treatment area and treat them, as necessary.

### **8. Operational Research**

*Goal: To carry out designed experiments in a scientific manner which will answer specific operational questions that will improve the ability to understand and predict West Nile virus activity, resulting in a more effective approach to WNV control and mosquito management.*

#### Background and Report on 2009 Activities

Following up on data collected in 2006 and 2007, the DCIP continued to evaluate two new mosquito traps on a larger scale. The traps were previously tested for their ability to collect mosquitoes and results showed that the BG-Sentinel trap with a BG-Lure and CO<sub>2</sub> was more effective in collecting the Asian tiger mosquito, and the Zumba trap baited with the BG-Lure and CO<sub>2</sub> proved to be a better trap for collecting WNV-infected host-seeking mosquitoes. These two traps were incorporated into 21 of the routine surveillance sites. Preliminary results showed that these two traps are excellent additions to the existing traps and will continue to be used in 2010. A project studying

the succession of mosquitoes in tires was continued in 2009 and included succession in black corrugated drain pipes.

#### Planned Activities for Operational Research

- Continue to document the importance of catch basins in the production of *Culex pipiens* in Fairfax County.
- Continue to evaluate specialized mosquito surveillance tools that are being developed by the industry.
- Continue to evaluate new mosquito collection methods (attractants and traps) to increase surveillance capabilities.
- Study the importance of certain artificial containers as larval habitat for *Aedes albopictus* and *Oc. japonicus*.

### **9. Adult Mosquito Control**

*Goal: To reduce the abundance of infected adult mosquitoes through the judicious use of pesticides in targeted areas when there is significant risk of mosquito-borne disease.*

#### Background and Report on 2009 Activities

While source reduction and the application of larvicides are the principal and most effective interventions to reduce mosquito populations, situations may arise in which infected adult mosquitoes are present in significant numbers and pose a threat to human health. In these situations, judicious application of adulticides to control mosquito populations will be added to all other mosquito control activities as an additional measure to reduce risk of illness and death in humans. WNV guidelines from CDC state that adulticiding based on surveillance data is an extremely important part of any integrated mosquito management program and should be used when there is significant risk of human illness.

Some of the insecticides that are used against adult mosquitoes include synthetic pyrethroids and malathion (an organophosphate) that have been used for more than 30 years and are registered by the U.S. Environmental Protection Agency and the Virginia Department of Agriculture for adult mosquito control in residential areas. These insecticides provide a rapid knockdown, killing adult mosquitoes upon contact. They also have low toxicity to mammals and birds, degrade rapidly in sunlight and water, and provide little or no residual activity. Most of these products do not bio-accumulate in animals.

There are two principal strategies in adulticiding that can be employed in mosquito control. One is to produce tiny droplets of insecticide from a machine (frequently mounted on a truck or aircraft) in such a way that a cloud of insecticide is produced. In this method, called Ultra Low Volume (ULV), the effect of the insecticide lasts a very short period of time and will only kill those mosquitoes which come in contact with these tiny droplets. A second strategy, called barrier spraying, is to lay down a thin, residual coat of insecticide on vegetation or man-made structures. In this case, the insecticide

lasts for a longer period of time and will kill any mosquito that comes into contact with the insecticide during the time that it is active.

In the event that ULV adulticiding is necessary, the FCHD will define the areas in the County where risk of WNV infection to humans is highest and which requires such action. Drivers and trucks from the contractor will be escorted down streets and roadways by police and will apply adulticide to the defined areas.

All adulticiding activities will be conducted under the direction of the County Executive and in consultation with MWCOG and the VDH, and in coordination with any affected county, city or town within or adjacent to Fairfax County.

Mosquito species and habitat, weather, time of year, the presence of the virus and the proximity of infected mosquitoes to human populations will be considered in determining the necessity for adult mosquito control. If the application of adulticides becomes necessary, the FCHD will provide advance notice to the public and health care providers in affected areas.

Prior to 2005, even in the years when there were human WNV cases, the use of insecticides against adult mosquitoes had not been indicated by the surveillance program. In 2005, 2006, and 2007 it was determined that it would be necessary to apply a barrier spray in an area where the surveillance program showed high WNV activity in the mosquitoes. Subsequent surveillance data showed that the barrier spray reduced the vector index, thus lowering the risk of WNV to humans in the area. All activities were conducted under the direction of the County Executive, and all of the residents in the affected areas were notified before treatment by hand-delivered letters. None of the human cases reported in Fairfax County were from these areas. In 2009, no adulticiding was deemed necessary.

At a minimum, the following factors will be considered when deciding the scope of the adulticiding effort:

- The general ecology of the area, e.g., key habitat types and the presence of natural barriers such as large rivers.
- The population composition, density, distribution, flight range and age structure (proportion of parous females) of the target mosquito species.
- The human population characteristics – spatial distribution and density relative to the positive locality (e.g. urban vs. rural), age demographics, etc.
- Evidence of persistent WNV activity detected by the surveillance program, season of the year, and how long WNV activity can be expected to persist until the epizootic/epidemic vector(s) enter diapause.

#### Planned Activities for Adult Mosquito Control

The presence of mosquito-borne pathogens in Fairfax County will result in one or more responses or interventions recommended by the FCHD. These interventions can range



from continuing existing surveillance, education, and outreach to the affected population to the targeted application of adulticides.

The FCHD will utilize its surveillance data to assess the risk of an outbreak of human disease and the need to apply insecticides in a limited and targeted area to control adult mosquitoes. Vector considerations include level of documented virus, the distribution and the density, age, and infection rate of the vector population. Other factors must also be considered before insecticide is used. Environmental considerations include habitat, time of year, weather conditions. The density and proximity of human populations are also considered before adulticide is used. Because these conditions can vary greatly and cannot be predicted, a consultation process with VDH, CDC and surrounding jurisdictions will be used to determine which, if any, responses are appropriate, on a case-by-case basis.

If adulticides are used to control mosquitoes, advance notification will be disseminated to surrounding residents indicating when and where the insecticides will be applied. This allows residents who wish to avoid exposure to take necessary actions and precautions. The Virginia Poison Control Center, area hospitals, and health care providers will be provided information on the pesticide being used. All insecticides considered for use are registered with the U.S. Environmental Protection Agency and the Virginia Department of Agriculture and will be used according to the label directions. When choosing pesticides for mosquito control, preference will be given to those insecticides that pose the least risk to humans and the environment.

In order to categorize the use of adulticides in Fairfax County, any responses initiated by the FCHD can be grouped into six broad categories or levels of risk. These levels are tailored after those of CDC, yet are modified to specifically reflect Fairfax County's position based on previous findings.

#### **Level 0**

Definition: Fall/winter; vector inactive, climate unsuitable for WNV transmission.

Response: Prepare material and equipment for the upcoming WNV season. Surveillance and control programs continue as outlined in the County's Surveillance and Control Plan. Identify locations where source reduction activities can be applied; secure surveillance and control resources necessary to enable response to WNV activity; initiate community outreach and public education programs; enhance communication with surrounding jurisdictions; recruit and train new staff; communicate with and educate large property owners of the importance of source reduction in areas such as cemeteries, golf courses, country clubs; communicate status of WNV activity to Director of the Health Department, the Board of Supervisors and the public, as the WNV season starts.

#### **Level 1**

Definition: Spring/summer/fall; anticipating WNV activity based on previous activity in region. No current surveillance findings indicating WNV activity in the area.

Response: Respond as in level 0, plus: continue and enhance source reduction; conduct larval control in identified breeding habitats where source reduction is not possible (emphasis will be placed on known *Culex* species breeding sites); continue community outreach and public education; begin monitoring avian mortality; work with other County departments on source reduction and mosquito control activities; initiate catch basin treatment rounds.

## **Level 2**

Definition: Spring/summer/fall; initial, sporadic or limited WNV activity in birds and/or mosquitoes.

Response: Respond as in level 1, plus: increase larval control activities; continue source reduction in cooperation with other County departments; and increase public education, emphasizing personal protection measures, particularly the use of products containing DEET, Picaridin, IR-3535 or oil of lemon eucalyptus. Enhance human surveillance and activities to quantify epizootic activity (e.g. mosquito trapping and testing) in areas of concern. Consider recommending to the public that they decrease outdoor activities when mosquitoes are biting.

## **Level 3**

Definition: Spring/summer/fall; initial confirmation of WNV in a human or a horse, or moderate WNV activity in birds and/or mosquitoes.

Response: Respond as in level 2, plus: expand public information programs (repellent use, personal protection, source reduction, risk communication about adult mosquito control program); prepare to implement adult mosquito control, if surveillance findings indicate the likely potential for human risk to persist or increase.

## **Level 4**

Definition: Spring/summer/fall; surveillance findings indicate high risk of human infection, (e.g. high or clusters of dead bird densities, high mosquito infection rates and vector index, multiple positive mosquito species, horse or other mammalian cases indicating increasing epizootic transmission, or a human case and high levels of epizootic activity) and abundant adult vectors.

Response: Respond as in level 3, plus: continue active surveillance for human cases; make final arrangements to implement adult mosquito control program in areas of potential human risk. The use of adulticides will be used in a limited manner as needed.

## **Level 5**

Definition: Spring/summer/fall; marked increase of confirmed multiple WNV cases in humans and conditions favoring continued transmission to humans.

Response: Respond as in level 4, plus: implement or intensify emergency adult mosquito control program; monitor effectiveness of adulticiding on target mosquito populations; coordinate adult mosquito control activities with surrounding jurisdictions. The FCHD activities related to adulticiding will include the following:

- CDC and gravid traps will be used in the treatment area if additional surveillance data are required.
- The FCHD will work with state entomologist and/or CDC personnel, as well as the contractor, to design and implement feasible measures to monitor the efficacy of the adulticiding activities.
- The public will be notified of adulticide schedules in advance. This will allow residents with special health concerns sufficient time to take any precautions to reduce pesticide exposure (see Public Education and Community Outreach).
- Hospitals will be notified regarding the adulticiding schedule. Information on the pesticide used will be provided to the public, physicians, and other health care providers.
- Adult mosquito control will be scheduled when mosquitoes are active and weather conditions are conducive to its success.
- Information will be released, in advance, through the media, the FCHD WNV Web page, and through news releases, the MSMS, as well as pertinent County and community.

**Table 2. Factors to consider when establishing thresholds for the use of larvicides, pupicides and adulticides to control mosquitoes to address public health threats**

Factor	Description	Consideration
Mosquito species	The ability of mosquito species to carry and transmit disease organisms; flight distance; feeding preferences; seasonality; type of breeding habitat; biology.	Often species and biology of the mosquito are more important in developing thresholds than relative abundance.
History of mosquito-borne pathogens in the area	Surveillance results of mosquito-borne pathogen activity in the area n mosquitoes, reservoir hosts of humans in the area.	Areas with evidence of mosquito-borne pathogens will likely be lower.
Proximity to human populations	The distance from potential mosquito habitats to human population centers (number and density).	The potential to produce large numbers on mosquitoes in close proximity to population centers may result in less tolerance and lower thresholds.
Weather patterns	Prevailing wind patterns, precipitation and temperatures.	High precipitation may produce man-biting flood water mosquitoes; prevailing wind patterns may carry mosquitoes to populated areas requiring lower thresholds.
Mosquito tolerance	Tolerance to mosquitoes varies from person to person.	Highly populated areas may require lower thresholds due to more intolerance to mosquitoes.
Natural predator populations	Balanced predator-prey populations may limit mosquito production.	Larval habitats that have high predator populations are adequate to control mosquito populations and may require higher treatment thresholds.
Type of mosquito habitat	Preferred developmental habitat for mosquitoes is species specific.	Since developmental habitat is species specific, adult nuisance mosquito species should be correlated to the specific habitat.
Water quality	Water quality influences mosquito productivity.	Since water quality can be species specific, adult nuisance mosquito species should be correlated to the specific habitat.
Water and vegetation management	Management of water levels and vegetation may reduce mosquito productivity.	Treatment thresholds should be higher where water level and vegetation can be managed.
Accessibility for surveillance and control	Developmental habitats may not have adequate access to surveillance or implement mosquito management.	Thresholds will be higher for areas that have limited access for surveillance and control
Non-target organisms	The presence of non-target organisms in the spray area and their susceptibility to the product used.	Minimize the impact of larvicides, pupicides and adulticides on non-target organisms by using the most target specific product, apply the product at the best time possible to minimize effect and use the least amount of product necessary always following label instructions.

## II. Tick and Tick-Borne Disease Surveillance 2009 Report and Comprehensive Plan for 2010

### Background

#### Public Health Impact

Tick-borne diseases continue to impact public health causing serious acute illness, chronic long-term illness and, sometimes, death. The recent and widespread encroachment of suburban sprawl into areas that were once farmland and the large deer populations in these suburban communities have increased the prevalence of disease-carrying ticks and the exposure of the human population to the diseases they carry.

Ticks are excellent vectors for disease transmission, second only to mosquitoes as vectors of human disease worldwide. They are the number one disease vector in the United States. Ticks carry and transmit a remarkable array of pathogens, including bacteria, viruses, spirochetes, rickettsiae, protozoa, nematodes and toxins. Furthermore, a single tick bite can transmit multiple pathogens--a phenomenon that has led to atypical presentations of some classic tick-borne diseases.

Ticks are among the most common disease vectors in the United States and are capable of transmitting *Borrelia burgdorferi* (the agent for Lyme disease), *Rickettsia rickettsii* (the agent for Rocky Mountain spotted fever), other spotted fever rickettsias, *Anaplasma phagocytophilum*, *Ehrlichia chaffeensis*, *Babesia microti*, the agents for relapsing fever, Colorado tick fever virus, [\*Francisella tularensis\*](#) (the agent for tularemia), *Coxiella burnetii* (the agent for Q fever), Powassan virus and tick paralysis.

#### Vector Biology

Knowledge of tick biology is important in understanding the tick's role in disease transmission and is equally important in the prevention of tick-borne diseases. There are four distinct life stages in a tick: egg, larva, nymph, and adult. The length of the life cycle and the number of hosts fed upon depends on the tick species. Most ticks have a two-year life cycle and will have from one to three hosts.

The essential characteristic of ticks, in terms of disease transmission to humans, is their need to ingest a blood meal to develop into the next stage of their life cycle. Ticks will take their requisite blood meal from all classes of vertebrates, with the exception of fish. Ticks find their host by questing, a behavior in which they perch in low vegetation and wait for a susceptible host to pass by, onto which they can attach and feed. Once on a host, the tick attaches its hypostome, a central piercing element with hooks, into the host's skin. Some ticks may secrete a cementing material to fasten themselves to the host, as well as anticoagulant, immunosuppressive and anti-inflammatory substances into the area of the bite. These prevent hosts from noticing ticks and thus aid the tick in

obtaining a blood meal. These same substances also help transmit any pathogens that the tick may be carrying.

### Introduction to Vector Surveillance

In light of the findings obtained through the pilot program in 2006, the DCIP continued tick surveillance in 2007. An enhanced surveillance program began in May and was halted in August of 2007. In 2008 and 2009, the DCIP also trapped white-footed mice at three sites. The white-footed mouse is a medically important species because it is the main reservoir host for the bacterium which causes Lyme disease; it is also a key host for black-legged ticks, which may become infected with and transmit Lyme disease.

Collecting ticks from dead deer during hunts was utilized in 2007-09 and will continue to be used in 2010. This remains to be a method of choice to collect black-legged ticks in Fairfax County.

In 2009, the DCIP used tick traps as the main source of surveillance and these activities continued throughout the year. Tick trapping efforts will expand and continue throughout 2010.

### **Interim Report and Action Plan, by Activity**

#### **1. Risk Communication, Community Outreach and Public Education**

*Goal: To increase the public's knowledge about Lyme disease and other tick-borne diseases; to promote behavioral change; and to encourage the community to take an active role in reducing their risk of tick-borne diseases through preventive measures.*

#### Background and Report on 2009 Activities

Demand for information about ticks and tick-borne diseases (particularly Lyme disease) continued to increase over the last year, and the Board of Supervisors once again requested that efforts be amplified in this area.

In 2009, 20-page "Reference Guide" on disease-carrying insects and the diseases they transmit, which included sections on the black-legged tick and Lyme disease was translated into Spanish and Korean, mailed to the corresponding ethnic groups and was made available to the public at all outreach events, as well as on the County Web page. The DCIP brochure on ticks and Lyme disease was also available and several thousand were distributed. The DCIP staff were invited to give several presentations throughout the County to a variety of groups where information regarding ticks and Lyme disease was also distributed. Tick and Lyme disease information and graphics were also incorporated into the DCIP 18-month calendar that was distributed through Fairfax County schools and to the public.

## Planned activities for Risk Communication, Community Outreach and Public Education

The following activities will be carried out in 2010:

- Update and expand the tick brochure to include new findings.
- Update the tick brochure to include new findings from 2009.
- Prepare a simple tick information card.
- Prepare and distribute a Lyme disease Tool Box primarily aimed at medical doctors.
- Prepare and distribute other educational materials on ticks and Lyme disease.
- Intensify outreach to the medical community emphasizing appropriate diagnosis, treatment, and prevention of Lyme disease via written educational materials and presentations.
- Distribute educational material at all relevant venues.
- Inform residents about personal protection and the actions they can take to keep their property free from ticks.
- Emphasize the importance of personal protection, the use of EPA-registered insect repellents, and proper dress when spending time outdoors.
- Stress the importance of tick checks on people and pets.
- Give presentations to community groups as requested.
- Prepare media alerts when necessary.
- Update the Web page on ticks, their control, the diseases they transmit, and personal protection.

## **2. Human Case Surveillance**

*Goal: To monitor the burden of tick-borne diseases (particularly Lyme disease) in Fairfax County through laboratory and physician case reporting.*

### Background and Report on 2009 Activities

In 2009, FCHD continued to use a system of passive surveillance to detect cases of Lyme disease and other tick-borne diseases and worked closely with local physicians and laboratories to improve the quality and timeliness of disease reporting. Modifications were made to the internal procedures for managing reported cases of tick-borne illness to improve efficiency and ensure more complete and accurate data collection.

Virginia state law requires that physicians, directors of medical care facilities and directors of laboratories report cases of Lyme disease, ehrlichiosis, Rocky Mountain spotted fever, and Q fever within one to three days of diagnosis (depending on the disease). All suspect cases of these tick-borne diseases reported to FCHD are investigated, classified, and entered into an FCHD database and the National Electronic Disease Surveillance System. Of note, anaplasmosis and babesiosis are not currently included on the Virginia list of reportable diseases.

In 2009, FCHD and VDH used the most current CDC surveillance case definitions for the four reportable tick-borne diseases. For Lyme disease (the most commonly reported tick-borne illness), this case definition uses the following classifications:

- *Confirmed*: a) a case of erythema migrans (an expanding rash that is the best clinical marker of the disease) with a known exposure, b) a case of erythema migrans with laboratory evidence of infection and without a known exposure, or c) a case with at least one late manifestation (involvement of the musculoskeletal, nervous and cardiovascular systems without an alternate explanation) and laboratory evidence of infection.
- *Probable*: any other case of physician diagnosed Lyme disease that has laboratory evidence of infection.
- *Suspected*: a) a case of EM with no known exposure and no laboratory evidence of infection, or b) a case with laboratory evidence of infection but no clinical information available.

For surveillance purposes, exposure to Lyme disease is defined as having been (less than 30 days before onset of EM) in wooded, brushy, or grassy areas (i.e., potential tick habitats) in a county in which Lyme disease is endemic (including Fairfax County). A history of tick bite is not required.

Laboratory criteria for confirmation of Lyme disease cases for 2009 were as follows:

- Positive culture for *Borrelia burgdorferi* from a clinical specimen;
- Two-tier testing interpreted using established criteria; or
- Single-tier IgG immunoblot seropositivity interpreted using established criteria.

#### Cases of Lyme Disease and other tick borne illnesses in Fairfax County in 2009

Using the case criteria outlined above, the FCHD detected and reported a total of 257 cases of Lyme disease in Fairfax County in 2009 (201 confirmed and 56 probable cases). By comparison, 191 confirmed and probable cases of Lyme disease were reported in 2008.

Six cases of Rocky Mountain spotted fever and 1 case of erlichiosis were reported in 2009. No cases of Q fever were identified.

Please note that 2009 data is subject to change as case reports from 2009 are finalized in the first several months of 2010.

#### Planned activities for Human Case Surveillance

In 2010, FCHD will continue to implement a passive surveillance system for human tick-borne diseases. In an effort to improve the quality and timeliness of Lyme disease reporting, particular emphasis will be placed on:

- *Educating the medical community*. FCHD will work to maximize physician reporting of Lyme disease by: raising awareness within the medical community of the increasing incidence of disease in Northern Virginia and the importance of timely and



accurate disease reporting; providing education regarding appropriate clinical and laboratory diagnostic criteria; and providing clearly outlined instructions for disease reporting.

- *Laboratory surveillance.* FCHD will continue to investigate all laboratory reports suggestive of Lyme disease that are submitted by commercial laboratories, hospitals, and physicians.

FCHD will also continue to encourage both physicians and laboratories to complete all essential information on Lyme disease reporting forms. Accurate classification of cases often requires knowledge of both the patient's clinical history and laboratory test results.

Please note: The Human Case Surveillance Plan for tick-borne diseases may be updated as needed to reflect local surveillance needs and changes to surveillance guidelines published by the VDH or the CDC.

### **3. Tick Surveillance**

*Goal: To determine the density and distribution of tick vector species (Ixodes scapularis) to estimate the prevalence of infectious agents (B. burgdorferi) in tick population.*

#### Background and Report on 2009 Activities

The black-legged tick (*Ixodes scapularis*) is the most important vector of human disease in Virginia and the primary focus of the DCIP's tick surveillance efforts. Nevertheless, we carry out surveillance of all the principal tick species collected in the County as well as the pathogens that they carry.

The 2009 tick-borne disease surveillance program included tick removal from deer (organized public hunts and controlled hunts with the County Wildlife Biologist) and an enhanced surveillance project that included tick trapping and mouse sampling (trapping, antibody detection, and tick removal).

In 2009, a total of 11,122 ticks were collected, the majority of which were lone star ticks (*Am. americanum*) (10,545). The black-legged tick or deer tick (*Ixodes scapularis*) was the second most common tick collected (546), followed by the American dog tick (*Dermacentor variabilis*) (31). A new tick, not previously collected in the County, (*Amblyomma maculatum*) the Gulf Coast tick, was also collected (6). A sample of all the ticks was sent to Johns Hopkins School of Public Health for pathogen detection since, as of 2008, DCLS no longer tests ticks.

This year 332 *Ix. scapularis*, were tested; of these 84 were positive for *Borrelia burgdorferi*, the causative agent for Lyme disease and 14 were infected with the non-pathogenic form of *Anaplasma phagocytophilum*. Table 3 shows the different infection rates of the developmental stages of this tick.

Tick Stage	Infection Rate (number tested)	Comments
Female	36.36 % (11)	Very few females were tested since most were collected feeding on deer. A component of deer blood lyses the Lyme-causing bacteria so a tick that has deer blood in it will almost always test negative even if it has been exposed to the bacteria.
Male	16.67 % (216)	Many males were collected from deer, but these had not fed. Since males pass through a nymph stage that may have fed on deer, it is expected that their infection rate could be lower than the nymphs'.
<b>Nymph</b>	<b>41.90 %</b> (105)	This is the stage that causes the most infections in humans; they are inconspicuous and many times not seen by the person it is feeding on.
All stages	25.30 % (332)	This infection rate is strongly influenced by the large number of males tested

**Table 3. Infection rates (percent positive) of *Ixodes scapularis* collected in Fairfax County, 2009.**

Fully- or partially-engorged female *Ix. scapularis* are not tested per laboratory protocol. Also 723 *Am. americanum* were tested for pathogens and 27 were positive for *Borrelia lonestari* and 31 for *Ehrlichia chaffeensis*. Of the 54 dog ticks tested, only two were infected with *Rickettsia montanensis*, a non-pathogenic *Rickettsia*. Of the six *Amblyomma maculatum* tested, four were positive for *Rickettsia parkeri*, a spotted fever group *Rickettsia*. Table 4 shows the ticks, tick pathogens identified this year as well as their infection rates.

Tick Species	Pathogen	Infection Rate % (number)
<i>Amblyomma americanum</i>	<i>Ehrlichia chaffeensis</i>	4.25 % (729)
<i>Amblyomma americanum</i>	<i>Borrelia lonestari</i>	3.70% (729)
<i>Amblyomma maculatum</i>	<i>Rickettsia parkeri</i>	66.67 % (6)
<i>Ixodes scapularis</i>	<i>Anaplasma phagocytophilum</i>	3.48 (402)
<i>Ixodes scapularis</i>	<i>Babesia microti</i>	0 % (408)
<i>Dermacentor variabilis</i>	<i>Rickettsia rickettsii</i> .	0 % (52)
<i>Dermacentor variabilis</i>	<i>Rickettsia montanensis</i>	3.85 % (52)
<i>Dermacentor variabilis</i>	<i>Rickettsia bellii</i>	0 % (52)

**Table 4. Tick pathogens and Infection Rates (percent positive) found in Fairfax County, 2009**

#### Planned activities for Tick Surveillance

The following activities will be carried out in 2010:

- Continue to conduct tick surveillance at 12 to 15 sites throughout the County.
- Associate tick data with risk factors to assess how to estimate human risk.
- Sort each collection by tick species and record information on location, collection data, trap type and the total number mosquitoes and test these for pathogens.
- Re-evaluate trap sites to be used during the 2010 season to ensure homogeneous coverage of the County.
- Conduct additional tick trapping in areas where conditions suggest a public health threat. This will help determine zones of potential local disease transmission and determine the extent of pathogen.
- Respond to residents' concerns regarding ticks in a timely manner.
- Collect ticks from at least two local veterinarians to increase the number of underrepresented species (i.e., the American dog tick).
- Participate in controlled deer hunts to obtain ticks from county, state and national parks and wildlife refuges located within Fairfax County.
- Seek out new deer hunts and new opportunities for tick collection.

#### **4. Tick Identification**

*Goal: To combat the threat of tick-borne diseases to County residents by providing a service for tick identification to species, stage of development, and relative degree of engorgement.*

#### Background and Report on 2009 Activities

There are four tick species found in Fairfax County that can transmit disease. The black-legged tick (*Ixodes scapularis*) transmits the bacterium which causes Lyme disease. The Lone Star tick (*Amblyomma americanum*) transmits the bacteria that cause Southern Tick Associated Rash Infection (STARI) and Ehrlichiosis. The American Dog tick (*Dermacentor variabilis*) which transmits the pathogen that causes Rocky Mountain Spotted Fever as well as other rickettsias that may cause spotted fever illnesses. The Gulf tick (*Amblyomma maculatum*) which transmits *Rickettsia parkeri* a pathogen that causes a spotted fever illness.

In 2008, we began advertising a tick identification service to encourage County residents to help raise awareness of Lyme disease and provide information on ticks and tick-borne diseases in the County. In 2009, we continued this service. One hundred fifty-eight specimens were brought to the Health Department for identification in 2009: 97 Lone Star ticks (*Amblyomma americanum*), 33 black-legged ticks (*Ixodes scapularis*), 24 American Dog ticks (*Dermacentor variabilis*), one spider, one head louse, one weevil, and one unidentified insect specimen.

#### Planned activities for Tick Identification

The following activities will be carried out in 2010:

- Encourage the public to bring in ticks for identification.
- Continue the tick identification service.
- Continue to stress the importance of tick checks on self, children, and pets.
- Provide those who bring in ticks for identification with appropriate information on ticks and tick-borne disease and make them aware of the symptoms of tick-borne diseases.
- Encourage medical attention if an engorged black-legged tick is identified.

### **III. Resources**

In 2010, the Fairfax County Disease Carrying Insects Program will be supported by the following resources:

#### **Fund 116**

One Entomologist (Program Supervisor)  
One Merit Outreach Specialist (EHS-III)  
One Merit Biologist (EHS-II)  
Two Limited-term Biologists (EHS-II)  
Six Limited-term seasonal staff (EHTech.-I) (May through October)  
One Limited-term Administrative Assistant

#### **General Fund (Health Department)**

One (10 percent) Environmental Health Specialists (EHS III) – GIS Specialist  
One (10 percent) Senior Administrative Coordination

#### **Other departments, agencies and jurisdictions**

Mosquito Surveillance and Management Subcommittee (MSMS)

#### **MSMS Members**

City of Fairfax  
City of Falls Church  
Fairfax County Department of Public Works and Environmental Services (DPWES)  
    Stormwater Planning Division  
    Maintenance and Stormwater Management Division  
    Forest Pest Management Program  
Fairfax County Department of Management and Budget  
Fairfax County Department of Information Technology  
Fairfax County Park Authority  
Fairfax Public Schools  
Fairfax County Health Department  
Fairfax County Office of the County Attorney  
Fairfax County Office of Public Affairs  
Fairfax County Police Department, Animal Control  
Town of Herndon  
Town of Vienna  
Virginia Department of Transportation

#### **IV. Mosquito and Tick References and Links**

Centers for Disease Control and Prevention (CDC)

Pesticides and Public Health: Integrated Methods of Mosquito Management

<http://www.cdc.gov/ncidod/eid/vol7no1/rose.htm>

West Nile Virus

<http://www.cdc.gov/ncidod/dvbid/westnile/index.htm>

Lyme Disease

<http://www.cdc.gov/ncidod/dvbid/lyme/>

Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH)

Information for Outdoor Workers

West Nile Virus

<http://www.cdc.gov/niosh/topics/westnile/>

Lyme Disease

<http://www.cdc.gov/niosh/topics/lyme/>

Centers for Disease Control and Prevention (CDC) and Environmental Protection Agency (EPA)

CDC/USEPA Joint Statement on Mosquito Control

<http://www.epa.gov/pesticides/health/mosquitoes/mosquitojoint.htm>

Environmental Protection Agency (EPA)

Insect Repellent: Use and Effectiveness

<http://www.epa.gov/pesticides/health/mosquitoes/insectrp.htm>

Larvicides for Mosquito Control

<http://www.epa.gov/pesticides/health/mosquitoes/larvicides4mosquitoes.htm>

Synthetic Pyrethroids for Mosquito Control

<http://www.epa.gov/pesticides/health/mosquitoes/pyrethroids4mosquitoes.htm>

Methods of Mosquito Control

<http://www.epa.gov/pesticides/health/mosquitoes/mosquito.htm>

Fairfax County Health Department (FCHD)

West Nile Virus and Lyme Disease Web Page

<http://www.fairfaxcounty.gov/fightthebite>

U. S. Geological Survey (USGS)

<http://westnilemaps.usgs.gov/>

Virginia Department of Health (VDH)

West Nile Virus Web page

<http://www.vdh.state.va.us/epidemiology/DEE/Vectorborne/WestNile/index.htm>

American Mosquito Control Association

<http://www.mosquito.org>

Virginia Mosquito Control Association

<http://www.mosquito-va.org/>